

## **Attachment G – Alternatives**

*Part 1 – Alternatives Considered and Rejected*

*Part 2 – TROA Components Considered and  
Rejected During Negotiations*

*Part 3 – Computer Analysis of Stream Flow and  
Recreational Pool Elements Considered for TROA*

## Attachment G

### Part 1—ALTERNATIVES CONSIDERED AND REJECTED

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To assist the negotiators in developing an operating agreement, numerous potential alternatives were evaluated. In one instance, the *Report to the Negotiators*, which is incorporated by reference and summarized below, was prepared to consider the possible effects of five alternatives against a no action alternative. In other studies, an extensive computer simulation effort was completed, which tested the capacity of a variety of stream flow and recreation pool elements to accomplish their intended purposes without infringing on the water rights of others. The results of this computer analysis are summarized at the end of this section.

The alternatives analyzed in the *Report to the Negotiators* were rejected by the negotiators for numerous reasons, but primarily because each alternative would have compromised Orr Ditch Decree water rights, and in many cases, would have been inconsistent with P.L. 101-618. A list of components rejected from further consideration in a draft TROA is given in part 2 of this attachment. As formulated, each alternative included mandatory flow or storage requirements and assumed water would be taken to fulfill those requirements without the permission of rightful water rights owners. For example, computer modeling showed the Stream Flow Alternative was likely to provide the least amount of water for Truckee Meadows agricultural and M&I water users because the alternative required the release of waters from storage when it was not usually needed for irrigation or M&I and, when released, those waters could not be diverted for other beneficial uses. In another instance, the Recreational Pools Alternative resulted in benefits accruing to uses without water rights (in the form of higher water levels in reservoirs) at the expense of existing, water-righted, downstream demands. A comparison of simulated shortages in water supplies under each of the action alternatives and no action illustrates the potential adverse impacts on M&I and agricultural water rights (Table 1).

Such actions were contradictory to P.L. 101-618, including section 205(a)(2), which requires water to be stored and released from Truckee River reservoirs to satisfy the exercise of water rights in conformance with both the Orr Ditch and the Truckee River General Electric decrees, except for those rights that are voluntarily relinquished. In addition, the possible adverse effects to water resources under each preliminary alternative were unacceptable to one or more of the negotiating parties.

Recognizing that an agreement was not likely to be concluded if mandatory restrictions interfered with the exercise of existing water rights, the negotiators discarded components of the preliminary alternatives when one or more parties determined that water rights would likely be adversely affected. For example, when an alternative to achieve stream flows requested by California Department of Fish and Game (CDFG) was evaluated, and

Table 1: Computer model results showing number of years (out of 97 years) when water supplies were insufficient to meet M&I or agricultural demand under each of the alternatives (abstracted from tables 4.13 – 4.17 of the *Report to the Negotiators*).

	No Action	Basic TROA	Stream Flow	Recreational Pools	Threatened & Endangered Species	California Assured Storage
Truckee Meadows M&I	13	14	17	14	15	16
Truckee Meadows Agricultural California M&I	7	10	14	11	14	10
Newlands Carson Div.	11	6	28	4	11	11
Newlands Carson Div.	6	6	8	7	7	7
Truckee Div.	7	8	12	11	9	8

modeling showed that requested flows could only be achieved by releasing stored water adverse to M&I and agricultural water rights in Nevada, the negotiators realized they would have to examine different flows and explore new ways to make water available for this purpose. This, in turn, lead to negotiations on such topics as exchange procedures, priorities for exchanges, accounting, and procedures for mandatory exchanges.

The negotiators did, however, retain aspects of the preliminary alternatives believed to be desirable and that were acceptable to the affected parties. For example, stream flow and recreational pool targets have been incorporated into draft TROA. Additionally, the negotiators incorporated a component of the preliminary California Assured Storage Alternative and agreed that California could store a portion of its unused surface water allocation in Truckee River reservoirs for M&I purposes. These and numerous other features of the preliminary alternatives identified in the *Report to the Negotiators* have been incorporated into the draft agreement.

## A. REPORT

In January 1996, the *Report to the Negotiators* was completed and circulated to all parties participating in TROA negotiations. The document was originally expected to serve as the basis for a draft EIS/EIR for the negotiated settlement. However, during review of the draft document, the TROA EIS/EIR Management Team concluded that numerous issues, whose environmental effects were still indeterminate, were still being negotiated, and it was premature to prepare a draft EIS/EIR. Consequently, the title of the document was modified, and it was distributed only to the negotiating parties. The purpose of completing the *Report to the Negotiators* was threefold - to provide analytical information requested by the negotiators; to emphasize issues raised during public scoping; and to provide the negotiators with additional information on potential impacts of proposals that were being considered.

The *Report to the Negotiators* included a NEPA-style analysis of five potential project alternatives. Even though numerous issues had yet to be resolved through negotiations at the time the *Report to the Negotiators* was completed, an alternative was created to represent some of the basic components of what was at the time thought to represent a TROA. Further, four additional alternatives were created to consider the predominant issues identified during the public scoping process - stream flow, recreational pools, threatened and endangered species, and storage of California water.

In reviewing the potential alternatives identified in the *Report to the Negotiators*, the negotiators recognized a number of important issues. Foremost among these was that water rights were adversely affected by each of the alternatives: frequently M&I water supplies recognized in the Orr Ditch decree. As formulated in the *Report to the Negotiators*, the alternatives would have taken water without the consent of the water right holder and precluded the storage and release of water by operations proposed in the alternatives. The potential Basic TROA Alternative had the least adverse impact on water rights, but it, too, created conditions that were adverse to water rights, and in some cases, did not comply with existing law. Recognizing the need to continue negotiations, the alternatives evaluated in the *Report to the Negotiators* were rejected.

The potential environmental impacts of the possible project alternatives were also evaluated using standard EIS/EIR techniques. Environmental resources in the study area were characterized under current conditions and also as projected to occur in the future without a TROA in place (the No Action Alternative). Future resources were also characterized as they might occur if each of the potential alternatives were in place. The results of these efforts were then compared to determine possible environmental impacts attributable to the alternatives. Potential impacts to water supply in the study area were given special attention through an extensive modeling effort to determine possible differences between the alternatives. A description of each alternative and a brief summary of some of the potential environmental impacts identified in the *Report to the Negotiators* are included below.

## **1. Report - Basic TROA Alternative<sup>1</sup>**

**a. Description.**—This alternative emphasized implementing the requirements of the PSA; i.e., to provide drought relief for Truckee Meadows and enhance spawning flows for endangered and threatened fish of Pyramid Lake. As part of this alternative, the portion of California's surface water allocation not needed to satisfy projected future water rights would remain in the Truckee River to serve downstream water rights. Existing mandatory minimum stream flows would be supplied according to existing procedures, and credit water stored pursuant to PSA could be exchanged to increase the potential for maintaining stream flows. Preferred stream flows were identified as being desirable but not mandatory for fish resources, and so were merely identified as targets for the Administrator. In addition, storage and releases of credit water could be

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<sup>1</sup> The Basic TROA Alternative represented draft TROA as negotiated as of 1995, and is substantially different from the TROA Alternative evaluated in the revised DEIS/EIR.

exchanged between reservoirs to achieve non-mandatory recreational pool storage targets.

**b. *Environmental Impact Summary.***—The Basic TROA Alternative was expected to increase the average volume of water stored in Lake Tahoe, as well as Prosser Creek, Stampede, and Boca Reservoirs. In addition, average flow in the Truckee River during the cui-ui spawning period was higher than conditions without a TROA in place. Although none of the alternatives improved water quality conditions in the Truckee River substantially, overall water quality was best under the Basic TROA and the Threatened and Endangered Species Alternative.

Water supply for M&I use in the Truckee Meadows was lower under this alternative than it was under the No Action Alternative. In contrast, California M&I water supplies were higher than under the No Action Alternative. Agricultural water supplies available to the Truckee Meadows and Carson Division were reduced under the Basic TROA Alternative. Truckee Division agricultural water supplies were the same as under the No Action Alternative.

The Basic TROA Alternative was anticipated to result in little change to conditions affecting biological resources in the study area from those projected for the No Action Alternative. In comparison to the other alternatives, the Basic TROA Alternative created the least favorable conditions the coldwater fish of Pyramid Lake.

Further, this alternative would reduce fall spawning by fish species found in Donner Creek, Independence Creek, Little Truckee River downstream from Stampede Reservoir, and the Truckee River because preferred and minimum stream flows would be met less often during fall months. In contrast, preferred and minimum stream flows were projected to be met much more frequently during the spring months, and spring-spawning fish species in all the streams and tributaries would benefit as a consequence. Riparian habitat in the study area would be inundated more frequently, resulting in a healthier riparian ecosystem and a beneficial effect on the associated biological resources.

The Basic TROA Alternative created more favorable conditions for cui-ui, bald eagles, osprey, and white pelicans than were anticipated under the No Action Alternative, but it appeared to restrict access of spawning LCT to Independence Creek during drought conditions.

The Basic TROA Alternative produced negligible impacts to recreational activities, recreational expenditures, agricultural activities, and cultural resources. Employment and personal income increased slightly in the study area, but no changes to population or air quality conditions in the study area occurred beyond those projected for the No Action Alternative.

## **2. Report-Stream Flow Alternative**

**a. *Description.***—The Stream Flow Alternative established mandatory minimum and preferred stream flows as identified by CDFG. The mandatory minimum flows were higher than existing minimum flows. By emphasizing stream flows, this alternative

responded to issues raised during scoping regarding general well-being of fish and wildlife, stream-based recreation, and water quality in the Truckee River. The alternative also responded to certain endangered species concerns by making spawning flows available for cui-ui.

The reservoirs would be operated to provide those mandatory stream flows by releasing all categories of water (pooled, fish, credit, and privately owned water). No storage credit would be provided to compensate for pooled water released. California's excess surface water—the portion of California's 10,000-acre-foot allocation not used to satisfy existing water rights—would be stored as Secondary Stored Water (referred to as Other Credit Water in TROA) and released to help maintain mandatory stream flows.

***b. Environmental Impact Summary.***—Model results showed the Stream Flow Alternative increased flows in the Truckee River, particularly during the summer months when flows are usually lowest. To sustain higher Truckee River flows, less water was stored in the upstream reservoirs. Average storage volumes for Lake Tahoe, Donner Lake, Independence Lake, Prosser Creek Reservoir, Stampede Reservoir, and Boca Reservoir were lower for this alternative than for any other alternative. In comparison to the other alternatives, environmental analysis indicated that the Stream Flow Alternative produced the best water quality conditions for Pyramid Lake.

California M&I water supplies and water supply for M&I use in the Truckee Meadows were lower under this alternative than under the No Action Alternative. Agricultural water supplies available to the Truckee Meadows, Carson Division, and Truckee Division were also reduced in the Stream Flow Alternative.

Since this alternative maintained less water in upstream lakes and reservoirs, it provided the least favorable conditions for biological resources at all the lakes and reservoirs except Pyramid Lake. Higher inflows to Pyramid Lake were expected to produce a greater quality and higher quantity of habitat for the coldwater fishery in the lake. At the other lakes and reservoirs, lower water levels were expected to reduce fish spawning success and survival and adversely affect waterfowl access to foraging habitat.

Populations of fall-spawning fish species in Donner Creek and the Truckee River were expected to be reduced because preferred and minimum stream flows were met less often during fall months in those tributaries. Conversely, fall-spawning fish populations in Independence Creek, Little Truckee River, and Prosser Creek were projected to increase because preferred and minimum stream flows were met more frequently.

The Stream Flow Alternative created the best stream flow conditions for spring-spawning fish species in the upstream tributaries and the Truckee River, and populations of those species were expected to increase. Riparian habitat in the study area would be inundated more frequently, resulting in a healthier riparian ecosystem and a beneficial effect on the associated biological resources.

Due to its high potential to maintain or recover the cottonwood riparian forest downstream from Derby Diversion Dam, the Stream Flow Alternative would provide benefits to a number of endangered, threatened, or sensitive bird species. It did not

improve conditions for cui-ui as well as the No Action Alternative, and it appeared to create the least favorable conditions at upstream lakes and reservoirs for eagles and osprey.

The Stream Flow Alternative was projected to have some minor adverse impacts on recreational expenditures due to lower water levels in the lakes and reservoirs. Impacts to agricultural activities, employment, and personal income in the study area were minor, and cultural resources, population, and air quality conditions were similar to those for the No Action Alternative.

### **3. Report-Recreational Pools Alternative**

*a. Description.*—The Recreational Pools Alternative was formulated to respond to the issue of lake- and reservoir-based recreation. It created mandatory storage targets for the Truckee River reservoirs from May through August with the intent of enhancing recreational opportunities during the recreation season. To achieve the mandatory reservoir storage targets, the alternative would limit all releases from storage or natural inflow any time storage was less than or equal to the established target.

*b. Environmental Impact Summary.*—This alternative was expected to create higher water elevation in Stampede, Boca, and Prosser Reservoirs throughout the year, particularly during the summer recreation season. Correspondingly, the volume of water stored in Lake Tahoe, Donner Lake, and Independence Lake was reduced compared to other alternatives. Truckee River flows were higher in the spring months during cui-ui spawning but lower during the other seasons.

Water supply for M&I use in the Truckee Meadows was lower under this alternative than under the No Action Alternative. By contrast, California M&I water supplies were higher. Agricultural water supplies available to the Truckee Meadows, Carson Division, and Truckee Division were also reduced in the Stream Flow Alternative.

The Recreational Pools Alternative was expected to provide benefits to most biological resources, particularly during the summer months when water elevations were higher to serve recreational interests. In comparison to the No Action Alternative, this alternative provided more favorable conditions for algae, aquatic invertebrates, fish, and waterfowl resources at most lakes and reservoirs in the study area.

Populations of fall-spawning fish species were expected to increase in Independence Creek, the Little Truckee River, and Prosser Creek because preferred and minimum stream flows would be met more frequently during fall months in those tributaries. However, populations of those same fish species were expected to be reduced in Donner Creek and the Truckee River because preferred and minimum stream flows were not anticipated to be met as frequently.

Preferred and minimum stream flows were projected to be met much more frequently during the spring months, and populations of spring-spawning fish species in all the streams and tributaries would benefit as a consequence. Riparian habitat in the study area

would be inundated more frequently, resulting in a healthier riparian ecosystem and a beneficial effect on associated biological resources.

The Recreational Pools Alternative created less favorable conditions for cui-ui than the No Action Alternative, restricted access to Independence Creek for spawning LCT during drought conditions, and created the least favorable conditions for the white pelican. Of all the alternatives, this alternative created the most favorable conditions for bald eagles and osprey at Stampede and Boca Reservoirs.

The Recreational Pools Alternative was expected to produce negligible impacts to recreational activities, recreational expenditures, agricultural activities, and cultural resources. Employment and personal income increased slightly in the study area, but population and air quality conditions in the study area were similar to those for the No Action Alternative.

#### **4. Report-Threatened and Endangered Species Alternative**

*a. Description.*—This alternative was designed to respond primarily to the issue of endangered and threatened fish species of Pyramid Lake. It established mandatory minimum stream flow requirements that were greater than existing minimum stream flow requirements in order to provide higher flows in the lower Truckee River during the spawning season. To achieve the desired flow targets, all categories of water could be released and exchanged irrespective of whether they could be re-stored or protected from depletion.

*b. Environmental Impact Summary.*—Model results indicated that flow in the Truckee River during the spring months for the Threatened and Endangered Species Alternative was substantially higher than for other alternatives. Average storage at Stampede, Boca, and Prosser Reservoirs was greater, while average storage at Donner and Independence Lakes was lower. Storage at Lake Tahoe was higher in the fall and winter months, but lower in the spring and summer. As noted earlier, the Basic TROA and Threatened and Endangered Species Alternatives appear to produce the best overall water quality conditions.

Water supply for M&I use in the Truckee Meadows was lower under this alternative than under the No Action Alternative. California M&I water supplies were similar to those of the No Action Alternative. Agricultural water supplies available to the Truckee Meadows and Carson Division were also reduced in the Stream Flow Alternative. Truckee Division agricultural water supplies were similar to those of the No Action Alternative.

This alternative was expected to produce higher flows in the lower Truckee River to respond to the requirements of listed fish species of Pyramid Lake, to the general benefit of biological resources in the lake. In addition, higher water elevations in several lakes and reservoirs would increase the aquatic food base and fish reproductive success compared to the No Action Alternative. Draw downs at these reservoirs were anticipated to occur less frequently than under the No Action Alternative, providing much better foraging and habitat conditions for aquatic resources.



Populations of fall-spawning fish species would be reduced in Donner Creek, Independence Creek, and the Truckee River because preferred and minimum stream flows were projected to be met less often during the fall months in these streams. Populations of these same fish species in Prosser Creek were expected to increase because preferred and minimum stream flows would be met in the creek during fall months.

Preferred and minimum stream flows were met much more frequently during the spring months, and populations of spring-spawning fish species in all the streams and tributaries would increase as a consequence. Riparian habitat in the study area was projected to be inundated more frequently, resulting in a healthier riparian ecosystem and a beneficial effect on the associated biological resources.

The Endangered and Threatened Species Alternative created favorable conditions for cui-ui second only to those expected under the California Assured Storage Alternative. However, it created less favorable conditions for LCT, bald eagles and osprey at Independence Lake, and the white pelican.

The Endangered and Threatened Species Alternative was expected to produce negligible impacts to recreational activities, recreational expenditures, agricultural activities, and cultural resources. Employment and personal income in the study area increased slightly, but population and air quality conditions in the study area were similar to the No Action Alternative.

## **5. Report-California Assured Storage Alternative**

**a. Description.**—The California Assured Storage Alternative was the State's preliminary proposal to maintain 50,000 acre-feet of carryover storage to serve beneficial uses in California. The State could store as much as 8,800 acre-feet each year in Prosser Creek and Stampede Reservoirs, and any unused portion of that storage could carry over from year to year. Total maximum carryover was set at 50,000 acre-feet.

**b. Environmental Impact Summary.**—Based on model results, average storage at Lake Tahoe and Stampede, Prosser Creek, and Boca Reservoirs was higher, and average storage in Donner and Independence Lakes was projected to be lower compared to the No Action Alternative. Spring flows in the Truckee River were higher than any of the other alternatives considered in the *Report to the Negotiators*.

Water supply for M&I use in the Truckee Meadows was lower under this alternative than under the No Action Alternative. In contrast, California M&I water supplies were higher. Agricultural water supplies available to the Truckee Meadows, Carson Division, and Truckee Division were also reduced in the Stream Flow Alternative.

With more water projected in most of the lakes and reservoirs in the study area, conditions affecting biological resources at the lakes and reservoirs were enhanced - the aquatic food base, reproductive success for fish, and foraging habitat for waterfowl were improved compared to the No Action Alternative.

Populations of fall-spawning fish species in Donner Creek, Independence Creek, the Little Truckee River, and the Truckee River were reduced because preferred and minimum stream flows were met less often in these streams during the fall months. Only in Prosser Creek were populations of these same fish species increased, as preferred and minimum stream flows were anticipated to be met in the creek during the fall months.

Preferred and minimum stream flows were met much more frequently during the spring months, and populations of spring-spawning fish species in all the streams and tributaries were expected to increase. Riparian habitat in the study area was inundated more frequently, resulting in a healthier riparian ecosystem and a beneficial effect on the associated biological resources.

The California Assured Storage Alternative created the most favorable conditions for all of all the alternatives considered in the *Report to the Negotiators*. It also created better conditions for a number of sensitive bird species than under the No Action Alternative.

The California Assured Storage Alternative was expected to produce negligible impacts to recreational activities, recreational expenditures, agricultural activities, and cultural resources. Employment and personal income in the study area increased slightly, but population and air quality conditions were similar to those for the No Action Alternative.

## **B. OTHER STUDIES**

Following distribution and review of the *Report to the Negotiators*, a number of potential elements were identified that warranted consideration for inclusion into the TROA. These elements focused on maintaining minimum stream flows that were higher than existing minimum flows and maintaining minimum recreation pools in the Truckee River reservoirs. To gain an understanding of how these elements and their variations might affect the exercise of water rights, a technical team completed an extensive computer simulation and analysis effort. The team divided this effort into three tasks:

Develop a list of elements that could enhance stream flows or recreational pools.

Review the list of flow- and pool-exchanging elements and dismiss those that would obviously violate the requirements of Section 205(a)(2) of P.L. 101-618.

Evaluate those elements not dismissed.

More than 100 computer simulations were produced. Results of the simulations were provided to the negotiators for consideration and incorporation into the proposed TROA as they determined appropriate.

The technical team concluded that simply setting higher minimum stream flows, as in the *Report to the Negotiators*, would not achieve the desired results because: (1) water rights would be adversely affected and (2) higher minimum flows would cause too much water to be released during dry periods in some reaches, which would occasionally drop flows

to zero as reservoir storage was exhausted. Through analyses of computer simulations, the technical team determined that creating and storing Joint Program Fish Credit Water and exchanging TROA water categories (e.g., Fish Credit Water and Non-Firm M&I Credit Water) among reservoirs could provide substantial benefits for stream- and reservoir-dependent resources by increasing the frequency at which minimum stream flows and recreation pools would be achieved. This led to the development of two sets (tiers) of minimum stream flows that promoted higher minimum stream flows than those that currently exist during wet and normal water years and conservation of M&I water during droughts. The two-tier flow system would be implemented by exchanging or restoring TROA waters among the reservoirs to supply, to the extent possible, the difference between the higher minimum flows and those that currently exist when those higher flows were not already being achieved. In addition, Sierra Pacific and the United States would voluntarily relinquish their rights to restore some of their water to meet the higher minimums under certain conditions. These exchanges and re-storage also increased the frequency of maintaining minimum recreational pools in Prosser Creek, Boca, and Stampede Reservoirs. A detailed description of the computer analysis is provided in part 3 of this attachment.

## **Attachment G**

### **Part 2—TROA COMPONENTS CONSIDERED AND REJECTED DURING NEGOTIATIONS**

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The following potential components of a TROA were considered by the negotiators and were rejected as being adverse to water rights or non-negotiable by one or more of the negotiating parties:

- Operate Truckee River reservoirs solely for maintaining stream flows
  - Maintaining minimum stream flows that are higher than those that currently exist, including between hydroelectric diversion and return points, for recreation, fish and wildlife resources, water quality, or aesthetics
  - Maintain constant flows (greater than current minimum stream flows) in the Truckee River Basin for lengthy time periods
  - Maintain optimum flows during average or greater water years
  - Meet spawning flow requirements for cui-ui
- Remove institutional constraints, such as the 1935 Truckee River Agreement
- Restrict the rate at which reservoir releases could be changed (increased or decreased)
  - Establish maximum release rates for Truckee River reservoirs
  - Establish maximum rates at which reservoir releases may be changed
- Release Credit, Other Credit Water, Private Water, Floriston Rate Water or Project Water solely for maintaining optimum stream flows, whether or not such releases could be exchanged for a similar release from another reservoir or re-stored downstream

- Restrict reservoir releases so that they do not cause stream flows to be greater than double the optimum stream flow
- Maximize the storage of Fish Credit Water in Stampede Reservoir by reducing the storage of Sierra Pacific M&I Credit Water
- Maintain access for Lahontan cutthroat trout to spawning habitat in Independence Creek by substituting storage release from Lake Tahoe for releases from Independence Lake to prevent water storage in Independence Lake from dropping below 7,500 acre-feet from May through July
- Distribute storage of PSA waters proportionally among the reservoirs to increase recreational opportunities at Truckee River reservoirs
- When water level in Independence Lake would be below the dam's release outlet, maintain minimum stream flows in Independence Creek by pumping water from storage
- Maintain the recreational value of Truckee River reservoirs by prohibiting releases below a certain level during the summer months
- Maintain the recreational value of Prosser Creek Reservoir by not releasing Prosser Project Water until after Labor Day
- Increase the M&I drought relief supply for Reno/Sparks by:
  - Establishing release schedules and exchange criteria for other waters
  - Maximizing M&I Credit Water storage in Stampede Reservoir
- Store California's surface water allocation (in excess of direct diversions) adverse to the storage of PSA waters and Floriston Rate Water

The following potential components of a TROA were considered by the negotiators and were rejected as being beyond the purpose and scope of TROA as directed by P.L. 101-618:

- Acquire water rights to maintain stream flows during drought conditions

- Use Orr Ditch Decree Claim Numbers 1 and 2 (agricultural irrigation claims) for cui-ui spawning
- Use Newlands Project water rights acquired for the maintenance of wetlands at Stillwater National Wildlife Refuge for the conservation of cui-ui
- Supplement fish populations in the Truckee River Basin with hatchery-reared fish
- Restore fish habitat in the Truckee River Basin degraded by constructing dams
- Maintain greater Donner Creek flows in the reach between Donner Lake dam and the confluence with Cold Creek by measuring flow immediately downstream from the dam
- Increase reservoir storage for recreation and fish and wildlife resources by increasing the storage conservation pools in Truckee River reservoirs
- Improve water quality in the Truckee River by decreasing the contaminant load and concentration of sewage treatment plant discharge
- Improve water quality in the Truckee River by applying sewage treatment plant effluent to land
- Use artificial means to improve dissolved oxygen levels in the Truckee River
- Increase the M&I drought relief supply for Reno/Sparks by:
  - Dedicating more water from the Truckee River to M&I use
  - Constructing Dog Valley Reservoir or other new reservoirs
  - Increasing water conservation beyond that required by PSA (Water Conservation Plan)
  - Eliminating mandatory minimum stream flows in Truckee River Basin tributaries
  - Pumping Lake Tahoe or Independence Lake
  - Removing all restrictions in the use of Private Water

- Importing water from other drainages
- Imposing greater conservation measures on agricultural activities
- Pumping groundwater from gravel pits near the Truckee River
- Restricting growth in the Reno/Sparks area
- Transporting water from Alaska by pipeline or tow ice bergs to nearby pumping areas
- Eliminating water deliveries to the Newlands Project
- Increase the water supply for threatened and endangered fishes of Pyramid Lake by:
  - Modifying Operating Criteria and Procedures for the Newlands Project
  - Lining water delivery canals in the Newlands Project
  - Allowing conjunctive use of surface and groundwater
- Modify Lake Tahoe storage and release operations as the channel configuration of the Truckee River changes
- Use Truckee River water recouped from amounts previously over diverted to the Newlands Project to improve and maintain stream flow conditions throughout the Truckee River Basin
- Re-draft the contract governing the use of Donner Lake storage to make more water available for stream flow maintenance
- Modify Lake Tahoe's storage limits to allow for more water to be available for stream maintenance

The following potential component of a TROA was considered by the negotiators and rejected as not allowing flexible reservoir management and conjunctive use of water:

- Use Prosser Project Water in Prosser Creek Reservoir for cui-ui before using water from Stampede Reservoir

The following potential components of a TROA were considered by the negotiators and rejected because the negotiators could not reach agreement:

- Increase stream flows to enhance recreation, fish and wildlife resources, and water quality by storing some of the water scheduled for late summer delivery to the Newlands Project in Truckee River reservoirs
- Use Lake Tahoe “federal water” described in the 1935 Truckee River Agreement for the benefit of threatened and endangered fishes in Pyramid Lake



## **Attachment G**

### **Part 3—COMPUTER ANALYSIS OF STREAM FLOW AND RECREATIONAL POOL ELEMENTS CONSIDERED FOR TROA**

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To assist TROA negotiators in developing the operating agreement identified in Section 205(a) of P.L. 101-618, a technical team tested the capacity of potential elements of a TROA to accomplish intended purposes without interfering with the exercise of water rights (unless voluntarily relinquished) and implementation of the Preliminary Settlement Agreement. One of the team's primary tasks was to explore ways to maximize the frequency of achieving minimum stream flow for fish and wildlife that California Department of Fish and Game (CDFG) recently recommended (greater than the minimum stream flows requirements that currently exist) and minimum recreational pools in the Truckee River reservoirs (includes federal reservoirs along with Donner Lake and Independence Lake). The team divided the task into three actions: 1) develop a list of elements that could enhance stream flows and recreational pools; 2) review the list and dismiss elements that would obviously violate their requirements of Section 205(a)(2) of P. L. 101-618; and 3) use computer simulations to evaluate those elements not dismissed above. The team then provided its analyses to the negotiators for discussion and incorporation into the proposed operating agreement as they determined appropriate. The following is an overview of the results provided to the negotiators.

#### **A. ELEMENTS DISMISSED**

After a general review of the elements list, the technical team eliminated the following from further consideration because they would have violated existing water rights if implemented or were deemed non-negotiable by the TROA negotiators:

1. Operating Truckee River Reservoirs only for maintaining stream flows
2. Removing institutional constraints, such as the 1935 Truckee River Agreement
3. Restricting the rate at which reservoir releases could be changed (increased or decreased)
4. Releasing Credit Water, Private Water, Pooled, or Project Waters solely for maintaining optimum stream flows for fish and wildlife, whether or not such releases could be exchanged for a similar release from another reservoir or re-stored downstream
5. Restricting reservoir releases when downstream flows exceed twice the optimum stream flows for fish and wildlife

## **1. Approach**

More than 100 computer simulations were generated in these analyses using the same hydrological model and 1901-95 hydrologic data base as in Chapters 3 and 4 of the Draft Environmental Impact Statement/Environmental Impact Report for the Truckee River Operating Agreement, February 1998. Each simulation included monthly flows at eight sites (primarily reservoir releases), water storage in six reservoirs, and the amount of water available in nine water categories. Since the Nevada Public Service Commission requires Sierra Pacific Power Company (Sierra) to have sufficient M&I water reserves to supply the Truckee Meadows service area during an extended drought, impacts to its water supply were simulated with 1901-94 hydrologic data followed by a repeat of the 1987 and 1988 water years, the first years of the recent eight-year drought (hereafter referred to as the 96-year period). The last year of the 96-year period was used as an “indicator year” for the worst case situation for M&I storage.

While these analyses characterized the No Action Alternative the same as in Chapter 3 (DEIS/EIR, February 1998), they varied those elements (storage, release, and exchange) of the TROA Alternative in Chapters 3 and 4 (DEIS/EIR, February 1998) for using different water categories, including Joint Program Fish Credit Water, to achieve various minimum stream flows regimes and minimum recreational pools. These minimum stream flow regimes, minimum recreation pools, and variations in exchanging and restoring Power Company M&I Credit, Fish Credit Water, Joint Program Fish Credit Water, Floriston Rate Water, Fish Water, Private Water, and Other Credit Water were evaluated in various combinations to identify impacts to stream flows, Sierra’s M&I water, and irrigation water available to the Carson Division of the Newlands Project.

The various water categories were evaluated for their capacity to support the following purposes:

- Maintaining current minimum stream flows, even if such releases cannot be exchanged or re-stored
- Maintaining minimum stream flows greater than those that currently exist, even if such releases cannot be exchanged or re-stored
- Maintaining the difference between current minimum stream flows and those that are larger, but only if such releases can be exchanged or re-stored
- Maintaining the difference between current minimum stream flows and those that are larger, whether or not they can be exchanged or re-stored
- Used as the last water category for maintaining minimum stream flows

- Maintaining preferred stream flows only
- Maintaining minimum recreational pools for Truckee River Reservoirs

CDFG's preferred stream flow regime, as used in Chapters 3 and 4 (DEIS/EIR, February 1998), was also used in these analyses. It is a set of continuous flows considered optimum for selected reaches of the Truckee River and its tributaries. Since it is usually not possible to achieve these stream flows without adversely affecting water rights, the computer simulations maintained the flow nearest the CDFG preferred flow regime (must be greater than mandatory minimum flow) that could be maintained for several months by adjusting scheduled releases (usually by extending the release period) and exchanging water among reservoirs without interfering with water rights.

A number of minimum stream flow regimes were tested in these analyses by comparing the frequency that stream flows recently recommended by CDFG were achieved or exceeded (tables 1 and 2). The current minimum flow regime contains mandatory reservoir releases currently required for certain reservoirs. Since these releases are usually not adequate for supporting self-sustaining fish populations in selected stream reaches, CDFG recently recommended a new set of minimum stream flows (hereafter referred to as CDFG minimum flow regime) that are greater than those that currently exist. The technical team developed a two-tier set of minimum stream flows (two-tier minimum flow regime) to provide greater flexibility for water management and to reduce adverse effects to water rights. This regime is comprised of two sets of minimum stream flows: During "non-dry water years" CDFG minimum flow regime is implemented, while during "dry water years", stream flow targets in CDFG minimum flow regime are reduced by half. The two-tier minimum flow regime was modified further (variations A and B) to allow greater flexibility in reservoir operations.

These analyses tested two sets of minimum recreational pool requirements for Donner Lake, and Prosser Creek, Boca, and Stampede Reservoirs from June through August. The first set only used the minimums associated with priority 1 given in table 3; these were targets, not mandatory limits. The second set used the minimums associated with all three priorities and established criteria for applying them. It emphasized maintaining priority 1 minimums for all four reservoirs. If these levels could not be maintained, storage was released from Stampede in lieu of releases from Prosser or Boca so that minimum pools could be maintained at priority 2 levels. If Stampede storage declined to 65,000 acre-feet, releases were made from Prosser and Boca until priority 3 levels were reached. Priority 3 minimums could not be violated unless releases were required to achieve minimum stream flows.

Use of water categories to support these minimum pools through exchanges and re-storage were evaluated by comparing computer simulations of frequency of achieving or exceeding minimum pools, Sierra's M&I shortage at the end of the 96-year period of analysis, and average annual shortage to the Carson Division of the Newlands Project.

Table 1.—Instream flow regimes (cfs)

	CDFG preferred	Current minimum	CDFG minimum	Two-tier	
				CDFG minimum	50% of CDFG minimum
Truckee River Tahoe to Donner	250	50-70	75	75	37.5
Truckee River Donner to Little Truckee River	300	0	100	100	50
Truckee River Little Truckee River to Stateline	200	0	150	150	75
Donner Lake release <sup>1</sup>	10-50	2-3	<sup>2</sup> 8	8	4
Prosser Creek Reservoir release	30-75	5	16	16	8
Independence Lake release	10-20	2	4-8	4-8	2-4
Stampede Reservoir release	100-125	30	45	45	23

<sup>1</sup> From November 15 through April 15, the gates of the dam are held open; therefore, inflow to the lake determines the outflow at the dam, and there is no required flow.

<sup>2</sup> Minimum release from Donner Lake from April through August becomes 5 cfs if the lake is forecasted to contain less than 8,000 acre-feet of water on September 1.

Two sets of comparisons were made: (1) using Joint Program Fish Credit Water as the last water to be used for minimum stream flows versus using such water to maintain minimum recreational pools and readily moving it among the reservoirs as necessary; and (2) using different combinations of the water categories to maintain minimum recreational pools and readily moving it among the reservoirs as necessary (as long as minimum stream flows were maintained and CDFG preferred flow regime was not exceeded) (table 4). Each simulation used variation B of the two-tier minimum flow regime.

## 2. Results of Streamflow Analysis

*a. Minimum Streamflows.*—Use of the current minimum flow regime with the No Action Alternative yielded varied results for reservoir releases achieving/exceeding CDFG's minimum stream flow recommendations (as shown in CDFG minimum flow regime) during the period of analysis (table 5). Releases from Prosser Creek Reservoir achieved or exceeded the recommendation at least 75 percent of the time, while releases from Lake Tahoe, Donner Lake, Independence Lake, and Stampede Reservoir achieved or exceeded the standard about 60-70 percent of the time. The frequency of achievement increased somewhat when the current minimum flow regime was used with TROA. CDFG recommended minimum stream flows were achieved or exceeded more frequently downstream from Donner Lake and Independence Lake. Achievement of flows was greatest when the

Table 2.—Variations of two-tier minimum instream flow regime

	A	B
Truckee River Lake Tahoe to Donner Creek confluence	<ul style="list-style-type: none"> <li>– Normal year: CDFG minimum flows</li> <li>– Dry year: 50% CDFG minimum flows</li> <li>– TROA waters provide amount not achieved with Pooled Water, but must be exchanged</li> </ul>	<ul style="list-style-type: none"> <li>– Normal year: CDFG minimum flows</li> <li>– Dry year: 50% CDFG minimum flows</li> <li>– Pooled Water used in accord with Tahoe/Prosser Exchange Agreement (up to 50-70 cfs)</li> <li>– TROA waters provide amount not achieved with Pooled Water, but must be exchanged</li> </ul>
Donner Lake release	<ul style="list-style-type: none"> <li>– Normal year: CDFG minimum flows</li> <li>– Dry year: 50% CDFG minimum flows</li> <li>– POSW provide difference between current minimum and CDFG or 50% CDFG minimums if storage criteria and recreational objectives are not violated and releases are exchanged</li> </ul>	<ul style="list-style-type: none"> <li>– Normal year: CDFG minimum flows</li> <li>– Dry year: 50% CDFG minimum flows</li> <li>– POSW provide difference between current minimum and CDFG or 50% CDFG minimums if storage criteria and recreational objectives are not violated and releases are exchanged</li> </ul>
Prosser Creek Reservoir release	<ul style="list-style-type: none"> <li>– Current minimum provided by release of Pooled and Uncommitted Waters</li> <li>– TROA waters provide difference between current minimum and CDFG or 50% CDFG minimums if releases are exchanged</li> </ul>	<ul style="list-style-type: none"> <li>– Current minimum provided by release of Pooled and Uncommitted Waters</li> <li>– If exchange possible: initially, 3 cfs of Uncommitted Water added during dry years and 5cfs during normal years, afterwards, TROA waters provide difference for a total of 8 cfs during dry years and add 6 cfs during normal years</li> </ul>
Stampede Reservoir release	<ul style="list-style-type: none"> <li>– Pooled Waters and Fish Water provide for current minimum</li> <li>– Normal years: TROA Waters provide difference between current and CDFG minimums</li> <li>– Dry years: TROA Waters used for 22.5 cfs if exchange possible</li> </ul>	<ul style="list-style-type: none"> <li>– Fish Water provides for current minimum</li> <li>– Normal years: Fish and TROA Waters proportionally provide difference between current and CDFG minimums</li> <li>– Dry years: If no Fish Water, TROA Waters used for 22.5 cfs if exchange possible</li> </ul>
Independence Lake release	<ul style="list-style-type: none"> <li>– POSW provides for current minimum</li> <li>– POSW provides for difference between current and CDFG or 50% CDFG minimums if restored after release</li> <li>– Minimum flow is 2 cfs when storage below 7,500 af</li> </ul>	<ul style="list-style-type: none"> <li>– POSW used to meet CDFG or 50% CDFG minimums – not necessary to restore</li> <li>– Minimum flow is 2 cfs when storage below 7,500 af</li> </ul>
Boca Reservoir release	– No mandatory minimum instream flows	– No mandatory minimum instream flows
Truckee River Donner Creek to Stateline	– No mandatory minimum instream flows	– No mandatory minimum instream flows

Table 3.—Minimum recreation pools and maintenance priorities

Priority	Reservoir storage (acre-feet)			
	Donner Lake	Prosser Creek	Boca	Stampede
1	8,000	19,000	33,500	127,000
2	8,000	19,000	26,000	65,000
3	6,300	11,000	22,000	62,000

Table 4.—Combinations of water categories tested for maintenance of minimum recreational pools (indicated by "X")

Combinations	Joint program Fish Credit Water	Credit Waters, Secondary Storage Water, and California M&I Water	Fish Water	Pooled Water
1	X			
2	X	X		
3	X	X	X	
4	X	X	X	X

CDFG minimum flow regime was used with TROA. In this case, modification of releases from all five reservoirs had substantial beneficial effects on stream flows. All reservoir releases, except Lake Tahoe, achieved or exceeded the recommendations more than 93 percent of the time during the period of analysis.

Table 5.—Frequency reservoir releases equaled or exceeded CDFG's recommended minimum instream flows

	Lake Tahoe	Donner Lake	Prosser Creek	Independence Lake	Stampede
No Action Alternative	58	70	75	59	64
TROA with current minimum regime	56	82	82	74	59
TROA with CDFG minimum regime	87	94	97	100	100

The creation of Joint Program Fish Credit Water has the potential to enhance stream flows by providing water to supplement the difference between the current and CDFG minimum flow regimes. This was evident in comparing two situations where only the current minimum flow regime was required but Joint Program Fish Credit Water was available to supplement the difference between current and high minimum flows (table 6). There was little difference between reserving Joint Program Fish Credit Water as the last water to be released and reserving it to supplement other releases relative to achievement of preferred stream flows. Both options appeared to substantially increase the frequency reservoir releases achieved or exceeded CDFG minimum stream flow recommendations.

Table 6.—Frequency reservoir releases achieved or exceed CDFG minimum instream flow recommendations with and without Joint Program Fish Credit Water (JPFCW)

	Lake Tahoe	Donner Lake	Prosser Creek	Independence Lake	Stampede
– No JPFCW	56	79	82	74	71
– Current minimum flow regime					
– JPFCW only used for difference between current and CDFG minimum flow regime	68	79	86	74	84
– JPFCW last water released for minimum instream flows	87	94	97	100	100
– CDFG minimum flow regime					
– JPFCW only used for preferred flow regime	87	94	97	100	100
– CDFG minimum flow regime					

Application of the two-tier minimum flow regime and its variations greatly improved reservoir releases for stream maintenance in comparison to using the current minimum flow regime, but improvements were somewhat less than using the CDFG minimum flow regime (tables 5, 6, and 7). Two-tier minimum flow regime variations A and B provided nearly the same results as the two-tier minimum flow regime for Donner Lake, Prosser Creek Reservoir, and Stampede Reservoir, but there was a marked difference in the releases from Lake Tahoe and Independence Lake. Since variation A of the two-tier minimum flow regime would not allow releases greater than those of the current minimum flow regime if they could not be re-stored, releases from Independence Lake achieved or exceeded CDFG recommended minimum flows 13 percent less often than with the two-tier minimum flow regime that required such releases. Variation B of the two-tier minimum flow regime yielded the same frequency as the two-tier minimum flow regime because releases to achieve minimum flows were not required to be re-stored. Variation B, however, modified releases from Lake Tahoe so that the minimum flows were achieved or exceeded 11 percent less often than the two-tier minimum flow regime because it replaced the release requirement of the Tahoe/Prosser Exchange Agreement, thus correcting the adverse impact to Floriston Rate Water caused by two-tier minimum flow regime-variation A.

Table 7.—Frequency reservoir releases achieved or exceeded CDFG minimum flow recommendations with the two-tier minimum instream flow regime and variations A and B

	Lake Tahoe	Donner Lake	Prosser Creek	Independence Lake	Stampede
Two-tier	82	88	91	87	88
Two-tier A	82	87	86	74	88
Two-tier B	73	88	87	86	92

### 3. Water Rights

A basic issue relative to stream flow maintenance concerned changing reservoir operations to give stream flow maintenance, both preferred and CDFG minimum flow regimes, priority over water rights. This water management strategy was tested by comparing simulations of Truckee River reservoirs operated to maintain stream flows as the top priority with simulations that operated the reservoirs primarily to serve water rights, the current operation. The simulations indicated that during extended droughts (1931-35 and 1988-94) the stream flow priority reduced Carson Division and Sierra's M&I supplies by 7 and 25 percent, respectively, compared to water right priority simulation. Because of adverse impacts to water rights, the question of operating reservoirs primarily for stream flow was eliminated from further consideration. All remaining simulations assumed that Truckee River Reservoirs were operated primarily to serve existing water rights.

Minimum flow regimes listed in tables 1 and 2 had markedly different effects on the Carson Division's irrigation supply and Sierra's M&I supply. Only the CDFG minimum flow regime adversely affected water available for the Carson Division. It reduced the average annual irrigation supply by about 3,000 af during the indicator year (last year of the 96-year period of analysis) as compared to the other three minimum regimes.

As with impacts to the Carson Division, implementation of CDFG minimum flow regime caused the greatest adverse impacts to M&I supply (table 8). By the indicator year of the 96-year period, the CDFG minimum flow regime had eliminated Sierra's storage and caused a shortage where none existed with any of the other flow regimes. This was caused by the release of M&I water to meet the higher flow requirements of the CDFG minimum flow regime. Though the regime required the release of water from all categories in storage, a substantial contribution was required of M&I Credit Water because it was the largest water category located in Stampede Reservoir during an extended drought.

Table 8.—Storage and shortages (acre-feet) in Sierra's M&I water during last year of 96-year period with different instream flow regimes

	Current minimum	CDFG minimum	Two-tier minimum	Two-tier minimum Variation A
Storage	6,920	0	5,690	3,300
Shortage	0	1,380	0	0

Though the two-tier minimum flow regime required greater minimum stream flows during non-dry years than the current minimum flow regime, the reduction in flow requirements during dry years with the two-tier minimum flow regime allowed nearly the same amount of water to remain in storage at the end of a drought as with the current minimum flow regime. This benefit, however, was adverse to Floriston Rate Water because the two-tier minimum flow regime required more to be released than required by



the Tahoe-Prosser Exchange Agreement or to achieve Floriston Rates. This was partly corrected in variation A of the two-tier minimum flow regime by requiring Credit Water to make-up the difference between the current minimum flow regime and the two-tier minimum flow regime-variation A (only if it could be exchanged or re-stored), but at the expensive of Sierra's M&I supplies. Variation A resulted in less M&I storage than with the current and two-tier minimum flow regimes because Credit Water released for minimum flows did not receive sufficient protection from spills and was not always available for its original purpose.

The creation of Joint Program Fish Credit Water caused less Fish Credit Water to be available for maintaining minimum stream flows. As a consequence, more M&I water would have to be released from storage to compensate for the shortfall. The magnitude of this impact on M&I water depended on what Joint Program Fish Credit Water was used for (e.g., preferred or minimum stream flows) and on the minimum stream regime required at the time. For example, at the end of the 96-year period of analysis, 5,220 af of M&I water was in storage when Joint Program Fish Credit Water was not created, but only 3,370 af in storage when Joint Program Fish Credit Water was stored and used for making-up the difference between the current minimum flow regime and the CDFG minimum flow regime. This reserve of M&I water was eliminated and a shortage created when the CDFG minimum flow regime was required and Joint Program Fish Credit Water was reserved as either the last water to be used for maintaining minimum stream flows or for supplementing preferred flows. When reserving Joint Program Fish Credit Water as the last to be used for minimum flows, shortage in M&I water increased 600 percent (9,540 af) over that when Joint Program Fish Credit Water was not created (1,380 af). Reserving Joint Program Fish Credit Water for preferred stream flow maintenance further aggravated M&I shortage by increasing it 700 percent (11,270 af) over that when Joint Program Fish Credit Water was not created.

The two-tier minimum flow regime eliminated the adverse effect of Joint Program Fish Credit Water on M&I storage and shortages. With the two-tier minimum flow regime, M&I storage conditions are nearly the same as those without Joint Program Fish Credit Water and the current minimum flow regime. Variation A of the two-tier minimum flow regime, however, only provided about half the storage because M&I Credit Water is relied on more to contribute to minimum flow maintenance.

#### Results of Recreation Pool Analysis

Use of the second set of minimum recreational pools that included all three priorities (in addition to mandatory minimum recreational pools) in table 3 was eliminated from extensive analysis because of the large potential to adversely impact water rights, and threatened and endangered fishes of Pyramid Lake. The first set of minimums (priority 1) was evaluated thoroughly because of its potential benefit to maintain minimum pools.

TROA increased the opportunities for maintaining priority 1 and 3 minimum pools, except for Donner Lake, when compared to the No Action Alternative (Table 9). The increases with TROA were due primarily to exchanges and re-storage of waters for

minimum stream flows, and attempts to achieve the minimum recreational pool targets. The low frequency associated with Donner Lake is do to higher minimum stream flow requirement in TROA than in the No Action Alternative.

Table 9.—Frequency priority 1 and 3 minimum recreational pools were achieved or exceeded with TROA (variation A of two-tier minimum flow regime) and the No Action Alternative

Reservoirs	Priority 1 minimum pools (af)	Exceedence frequency (percentage)		Priority 3 minimum pools (af)	Exceedence frequency (percentage)	
		TROA	No Action Alternative		TROA	No Action Alternative
Donner Lake	8,000	60	75	6,300	85	100
Prosser Creek	19,000	12	12	11,000	58	40
Stampede	127,000	68	53	62,000	55	47
Boca	33,500	22	13	22,000	95	71

The use of Joint Program Fish Credit Water for minimum recreational pools did not increase the frequency of maintaining priority 1 minimum pools when compared to reserving such water as the last to be used for maintaining minimum stream flows (Table 10). Using another water category with Joint Program Fish Credit Water slightly increase the frequency, but using more than one additional water category with Joint Program Fish Credit Water did not increase the occurrence.

Table 10.—Frequency priority 1 minimum recreational pools were achieved or exceeded with exchange/re-storage of difference water category combinations (see table 4)

	Priority 1 minimum pools (af)	Exceedence frequency (percentage)				
		Joint Program Fish Credit Water last used for minimum instream flows	Comb. 1	Comb. 2	Comb. 3	Comb. 4
Donner Lake	8,000	60	60	73	73	73
Prosser Creek	19,000	12	15	22	22	29
Stampede	127,000	68	65	63	63	71
Boca	33,500	22	22	29	29	29

Using Joint Program Fish Credit Water for minimum recreational pools, rather than for minimum stream flows, substantially increased (25 percent) Sierra's M&I storage without markedly increasing (less than one percent) the average annual shortage to the Carson Division (table 11). Dedicated other water categories along with Joint Program Fish Credit Water to minimum recreational pool maintenance noticeably decreased (79-94 percent) Sierra's M&I storage and increased (1-9 percent) Carson Division average annual shortage.

Table 11.—Comparison of Sierra's M&I storage and Carson Division shortage with the exchange/re-storage of difference water category combinations

	Sierra storage (af)	Carson Division shortages (af)
Joint Program Fish Credit Water last used for minimum instream flows	3,650	3,760
Combination 1	4,870	3,770
Combination 2	1,020	3,810
Combination 3	180	3,820
Combination 4	990	4,150

#### 4. Summary

Exchanges and re-storage of Credit Waters among the Truckee River reservoirs and the creation of Joint Program Fish Credit Water enhanced the capacity of a TROA to increase the frequency that reservoir releases achieve or exceed CDFG minimum stream recommendations and that minimum recreational pools are maintained. However, adverse impacts to water rights varied appreciably with the different combinations of exchanges, water categories, minimum stream flow regimes, and minimum recreational pools. For example, requiring reservoir releases to be no less than the CDFG minimum flow regime would greatly enhance stream flows, but would be adverse to water rights and recreational pools. Conversely, requiring reservoir releases to be no less than the current minimum flow regime would not substantially enhance stream flows, but would enhance Sierra's M&I supplies and recreational pools. The best scenario incorporating stream flows, recreational pools, and M&I supplies appears to be the two-tier minimum flow regime-variation B, with Joint Program Fish Credit Water used for maintenance of minimum recreational pools. Implementation of this scenario would require the Department of the Interior and Sierra to voluntarily relinquish rights to re-store some of their waters under certain conditions.